

# Final Report of the Governor's Rocky Flats Scientific Panel on Monitoring Systems

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Submitted to
Governor Romer
The U.S. Department of Energy
The Colorado Department of Health

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# EXECUTIVE SUMMARY

On July 7, 1989, Governor Romer created the Rocky Flats Scientific Panel on Monitoring Systems to study the existing environmental monitoring systems in place around the Rocky Flats Plant (RFP).

Air, radiation, and water committees were established to investigate the adequacy of monitoring systems at the RFP and to recommend any necessary changes. Each committee assisted the full panel in understanding and interpreting information from their respective areas of expertise. Representatives from the Colorado Department of Health (CDH), the Rocky Flats facility, the Environmental Protection Agency, local governments, and interested citizens provided valuable assistance to the panel.

The panel determined that monitoring activities at the Rocky Flats Plant can be improved with a number of additions and modifications. A major finding of the panel was the need for a complete environmental information system for the Rocky Flats Plant. Currently, there is no overall purpose behind the great amount of data produced by the facility and how it is to be used in correlation with the monitoring systems.

Well-defined and documented procedures for computerizing the data, reporting the resulting information, and using this information in management decisions are essential in order to ensure "adequate" monitoring at this facility.

The panel is also concerned about the lack of information exchange between various interested parties. A computerized system should be developed that will allow for timely, accurate and easy exchange of information between the plant, the Colorado Department of Health, the Environmental Protection Agency and local governments. Data management activities would be greatly aided by computerization. Because the monitoring data are too complex to be examined by eye, it requires mathematical and statistical treatment, graphical display, and computer assisted analysis. In order for this information to be better understood, all data for the plant should be presented using a standard reporting protocol. This would allow data from different time periods as well as sources to be readily compared.

Additionally, a comprehensive, integrated quality assurance/ quality control (QA/QC) plan needs to be developed and implemented. The panel believes that the most important aspect of a monitoring system is a QA/QC program performed by the Rocky Flats Plant contractor that can be independently audited. CDH, RFP, and local governments should work together to standardize the measuring and testing protocols to allow for comparison of data.

While there appears to be adequate planning for emergencies, a better plan for response to unplanned non-emergency events is needed. For example, when water must be released from the ponds at the plant, an adequate response plan will allow for the immediate notification of all potentially affected entities and a timely decision on what actions need to be taken.

The panel is concerned about the actual size of the particles to which plutonium becomes attached and how these particles may be transported across the plant boundary. We recommend that a large-particle sampler program be established to better characterize plutonium pathways. Additionally, there is a need to characterize the way particulates are transported across the plant boundary.

Due to changes in environmental conditions at the plant as well as changes in potential contamination caused by construction and cleanup activities, the panel recommends that a mobile sampling van program be established. This would allow monitoring to take place where fixed monitoring does not exist.

Interpretation of ground water sampling data is hampered by the presense of a number of wells without proper documentation on their construction. The data obtained from these wells are of limited value. These wells should be discontinued from the monitoring plan.

More accurate soil plutonium isopleths should be drawn. Before proceeding with further sampling, it is important to determine if enough data may be available from the Colorado Department of Health and other sources.

If it can be determined that the Rocky Flats Plant uses principally depleted uranium, it would be beneficial to report the U-234/U-238 ratio for uranium analysis. This would help in understanding the amount of uranium in the environment due to plant activities vs. uranium concentrations occuring naturally.

In order to address public concerns, a one-time analysis of forage and foodstuffs raised in the vicinity of the RFP should be conducted. Additionally, periodic sampling of the nearest down-gradient wells should be conducted. The results of these studies should be compared with background levels of contamination to determine the source of any pollutants that are detected.

There are a number of research projects that will aid in the development of improved monitoring systems. The panel has requested that the ASCOT (Atmospheric Studies in Complex Terrain) program conduct research in the Front Range area of Colorado and we have been informed that the ASCOT program will move to Colorado in Fiscal Year 1991. This program should greatly improve the understanding of meteorological flow and pollutant dispersion around the RFP. The panel also supports continued development of the TRAC (Terrain Responsive Atmospheric Code) model so that it can be used as a prognostic model to provide short range forecasts of pollutant dispersion.

The panel believes that it has identified the most critical monitoring needs and made its best effort to outline cost-effective management strategies in the areas of sampling, measurement and data analysis. Still, it is not possible to anticipate all of the potential hazards posed to community health and safety. Excellent monitoring systems have great potential for detecting environmental contaminants, but cannot guarantee public health and safety.

All panel members support the recommendations in the full report. Each of the three attached committee reports represent separate deliberations by individual committees and have not been fully reviewed or endorsed by the panel.

The recommendations of the panel are based on information provided to it for a limited period of time. The panel believes, though, that the success of a monitoring system depends on a continuous review process to ensure that the system is responsive to changing technologies and conditions.

The recommendations of the panel are not intended to endorse or exclude any particular process, company or individual. The panel recognizes that best state-of-the-art technology is continually developing and improving.

## 1.0 INTRODUCTION

Public concern about the health effects of living near the Rocky Flats Plant has been present for several decades. The principal focus of this concern has generally been radioactivity in effluent from the plant. Reports of radioactivity in public water supplies, soils surrounding the plant, and in the air have led to fears for the health of nearby residents. In addition, many other environmental pollutants are associated with industrial production, and people are concerned when intense media attention is given to possible low-level, long-term effects of many of these materials.

The Rocky Flats Plant uses many chemical compounds in its production processes. Some of these compounds have been identified as health hazards, either through direct observation of their affects on humans or as extrapolations from their affects on laboratory animals. If significant quantities of either radionuclides or industrial chemical contaminants escape from the plant, it is essential that monitoring systems are in place and that those systems are designed and operated in such a manner that they are capable of detecting the pollutants, quantifying them, and providing appropriate warnings of the potential for human exposure.

Information presented to the public with regard to the Rocky Flats Plant effluents must be accurate, credible and understandable. Appropriate environmental monitoring can provide this information. Interpretation of environmental data by a credible agency is also critical. Without such interpretation, the public is left to infer that any chemical or radionuclide release from activities at Rocky Flats represents a potentially serious hazard to human health and the environment.

To assist in assessing the quality of monitoring systems at the Rocky Flats Plant (monitoring programs are operated by the Rocky Flats Plant, the Colorado Department of Health, and associated cities), Governor Roy Romer established the Rocky Flats Scientific Panel on Monitoring Systems. The panel, after receiving its charge from the Governor, established the following objective:

> "To determine whether or not current and proposed monitoring systems are adequate to detect release, distribution and concentrations of materials in amounts recognized as hazardous to human health, and if the information has been collected in a condition suitable for analysis, modeling and interpretation, and to recommend corrections as necessary."

Air, radiation, and water committees were established to investigate the adequacy of monitoring systems at the Rocky Flats Plant and to recommend any necessary changes. Each committee was responsible for assisting the full panel in understanding and interpreting information from their respective areas of expertise. Panel members represent a wide variety of expertise and experience. A list of panel members and their credentials is presented in Appendix 3.2.

This study was limited in scope to the specific subjects outlined in the charge to the panel. The review of measurement capabilities and objectives were limited to those related to community health and safety and specifically excluded plant worker health and safety.

The panel had no power of subpoena and depended entirely on what others chose to relate or show. It was unable to independently check the veracity of most facts, data, procedures or assertions, whether provided verbally or in writing. In most instances, it received excellent cooperation from employees of Rockwell International, EG&G, the Department of Energy, the Environmental Protection Agency, the Colorado Department of Health, local government officials, interest group members, and citizens. All panel meetings were open to the public and comments were sought and considered. Information was provided to the panel when requested, but it was often raw data in a form not readily suited to analysis and review.

The Panel believes that it has identified the most critical monitoring needs and made its best effort to outline cost-effective management strategies in the areas of sampling, measurement, data analysis. Still, it is never possible to anticipate all of the potential hazards posed to community health and safety. Excellent monitoring systems have great potential for detecting environmental contaminants, but cannot guarantee community health and safety. Monitoring is not intended to provide protection, and no amount of monitoring provides protection from the possible occurrence of acute episodes, such as fires, explosions, accidents, tornadoes, earthquakes, and sabotage. If fires or other episodes occur, monitoring systems can measure concentrations of releases into the environment. Such measurements will aid in estimating the magnitude of potential adverse effects, potential pathways for human exposure and help project the eventual fate of the material.

A further problem arises from the imperfect state of knowledge of the extent of hazard to various receptors of hazardous materials. Therefore, the panel makes no representation as to what is safe or an acceptable level of hazard.

## 2.0 RECOMMENDATIONS

It is important to emphasize that the information presented here represents a simplification and consolidation of the three individual committee reports and that the information contained in these reports is not completely described in the following recommendations. The reader is referred to individual committee reports for additional information on specific recommendations.

### 2.1 GENERAL RECOMMENDATIONS

1. A total environmental information system for the Rocky Flats Plant should be designed and implemented.

The panel examined existing documents for a clear indication of a rationale for the design and operation of the current Rocky Flats Plant monitoring system. The panel had a difficult time evaluating the design and operation of the monitoring system because of the difficulty in finding documentation on information goals. There does not seem to be an overall information purpose for the monitoring effort. There are defined objectives for the collection of data, but no objectives exist for the transfer of these data into useful information. There are no well-defined and documented procedures for computerizing the data, reporting the resulting information, or using the information in management decision-making. The State of Colorado, the Rocky Flats Plant and local governments should begin to develop a comprehensive monitoring information system. There are a number of considerations that must be taken into account when developing such a system. Details on what needs to be considered when developing an "ideal" monitoring information system is included in the Water Committee report.

2. Computerization for all information objectives is essential.

The effectiveness of the monitoring program depends as much on data availability as it does on the data quality. The number of samples being analyzed from the plant and the number of chemical variables being determined on these samples is already large and is likely to grow rapidly. The data management task is too large to be handled by paper documentation. A computerized data management system is essential to the efficacy of the monitoring system. The data obtained in the monitoring activities should be entered into a computerized database as quickly as the data are obtained, using direct on-line data acquisition wherever possible.

The database should also include the quality control documentation generated by the quality assurance and quality control (QA/QC) program. These qualifying data should be co-residents with the monitoring measurements so that data quality judgments can be made quickly and efficiently. A centralized database should be designed to provide quick access of information to plant monitoring personnel, the Colorado Department of Health, and other state and municipal agencies. At a minimum, the near-term plan should enable individuals to acquire monitoring data in a magnetic image (tape or diskette). The data system should be capable of archiving all of the routine monitoring data and the quality control documentation.

In the long-term, it may be necessary to create a network connection (telecommunication link) between RFP and the Colorado Department of Health. The existing reporting system (paper transmittal of tabular data) is not capable of supporting a timely and robust data analysis protocol. A data analysis protocol should be developed and implemented. The monitoring data are too complex to be examined by eye, they require mathematical and statistical treatment, graphical display, and computer-assisted data analysis. At present, the data are not being fully exploited for their information content because neither the Rocky Flats Plant nor the Colorado Department of Health have computerized their evaluation of monitoring data.

A Data Management Specialist may be needed to develop and manage the data system and to assist in developing statistical summaries and reports. The Data Management Specialist could provide a useful conduit for communication between the information suppliers and information users.

3. A standard reporting protocol should be developed, implemented and utilized by all agencies that obtain data from the Rocky Flats Plant.

A standard reporting protocol for all information obtained from the Rocky Flats Plant should be developed and implemented. This would enable information to be more easily understood as well as allow for easier comparison of data presented by various agencies. Environmental monitoring programs for all agencies responsible for the Rocky Flats Plant should be published in a single document suitable for public use. Monitoring programs and data should be described in the same format using both tables and text to assure the public that all potential pathways of human exposure are being adequately monitored. Examples of reporting formats are located in Appendices 3.5 and 3.6 and are explained in the Water Committee Report.

4. DOE should institute an active program for model validation.

These models would include those used to estimate plutonium concentrations in environmental media due to routine releases from the plant, resuspension of contaminated soils, and unusual events. Much of the model validation effort would center around atmospheric transport; however, models for all transport of plutonium through the ecosystem should also be validated.

5. Best state-of-the-art techniques should be used for all monitoring.

There are many new state-of-the-art techniques that have been developed that would improve the veracity of the monitoring system. Some of these are discussed within the attached committee reports. However, since technology is continually being developed, review of new developments and application of new technology should be a continuous process.

6. Background radiation data should be fully characterized for all media surrounding the plant.

Additional data should be obtained to characterize not only background radiation levels but the variability of these levels in areas unaffected by the plant. It is important to compare concentrations of radionuclides measured in environmental media at the plant site with background radiation levels. Background radiation comes from naturally occurring radioactive substances in the soil, cosmic radiation from outer space and from the fallout that has occurred from above ground testing of nuclear weapons.

7. A mass balance of materials into and out of the Rocky Flats Plant should be compiled.

In a large fabrication facility such as the Rocky Flats Plant, it is difficult to estimate with precision likely emissions into the environment. The potential for releases of toxic substances into the environment is greatly affected by the manner in which these materials are handled and processed. One conservative approach would be to assume that virtually all of the material used by the plant each year is lost to the environment. Such an approach sets an upper limit on the maximum community exposure. This conservative approach may reflect reality for volatile species such as carbon tetrachloride or 1,1,1-trichloroethane. Conversely, this approach will likely overestimate the potential for releases into the environment of such materials as beryllium, the majority of which leaves the plant as finished product.

Because a materials balance approach is one way to identify hazardous materials used in sufficient quantities to warrant attention and, possibly, monitoring, the panel requested from Rocky Flats management a list of the 19 chemicals used in the largest quantities, as defined by a SARA III-Toxic Chemical List. The amounts used should not be confused with the amounts likely to have been released to the environment.

The largest amount of any toxic chemical reported to be used at Rocky Flats from the SARA III List is carbon tetrachloride (a degreasing agent). The SARA III List estimated that 130,000 pounds of carbon tetrachloride are released annually with 180,000 pounds being used annually. The 19th most used chemical is toluene diisocyanate, a polymer precursor with an annual reported use of only 110 pounds. Beryllium and radioactive element use rates were not disclosed to the panel for security reasons. Nonetheless, these species are being, and will continue to be, monitored.

From the Sara III List it was determined that the following non-radioactive species require monitoring in ambient air. These are beryllium, carbon tetrachloride and 1,1,1-trichloroethane, oxides of nitrogen (NO, NO2, HNO3), hydrogen fluoride, and methylene chloride.

8. A day-to-day plan for the timely response to unplanned pollutant releases should be more fully developed.

An unplanned event is different from an emergency event. A decision has to be made in an unplanned event but not in the same time frame as in an emergency situation. An example of an unplanned event would be a decision to release water from the ponds at the Rocky Flats facility. This requires that decisions be made expeditiously but time is not as critical as during an emergency event. A formal plan will ensure that a timely decision can be made on what actions need to be taken.

9. The feasibility of developing indices needs to be studied.

Indices, if properly developed, could be beneficial in interpreting data obtained from the monitoring systems at the Rocky Flats Facility. An indice is a form of measurement which would provide relational indicators that convey general environmental status to management personnel and could be used to summarize this status to the public. The development of indices could enhance the credibility of the monitoring system by providing sensitive and understandable and accurate reports to the public. Additional information on the development of indices is contained within the Water Committee Report and in Appendix 3.6.

10. The U-234/U-238 ratio should be reported for uranium analysis.

The type of uranium used at the Rocky Flats Plant is assumed to be primarily depleted uranium. If this is the case, the isotopic ratio of U-234/U-238 for the Rocky Flats Plant derived uranium would be significantly less than 1.0, while the ratio for natural uranium is close to 1.0. Information regarding this ratio may be important to identify sources of uranium in the environment. It is very important that the public be informed properly with regard to natural background concentrations of primordial radionuclides and the variability along the Front Range.

11. Resources should be made available for independent research projects.

An example of independent research at the Rocky Flats Plant is the consortium that the Governor is assembling to deal with hazardous materials management, minimization, environmental protection and restoration, and waste treatment. This entity could be useful in managing and overseeing the independent research funded for DOE and others.

The center intends to have representation from public research universities of the state (CSM, CSU, and CU), from community colleges with training programs in waste management, from industry, from the Colorado Department of Health and others. Currently, the consortium is referred to as the Colorado Center For Environmental Management, with activities to be conducted at the Rocky Flats Plant and other contaminated sites throughout Colorado. This consortium is defining its mission in the area of research and development, education and training and technical assistance which will assist in cleaning up contaminated sites throughout Colorado including the Rocky Flats Facility.

It is important that there be broad Colorado participation in the consortium and center to help restore community confidence in the monitoring of environmental quality, community health and worker safety. This is an important Colorado activity, and it is not acceptable for DOE to assert that all needed research will be done through its national labs elsewhere.

## 2.2 QUALITY ASSURANCE (QA)/QUALITY CONTROL (QC)

12. A comprehensive, integrated QA/QC plan should be developed and implemented.

A comprehensive QA/QC program is an integral part of any monitoring system. There are many improvements that could be made in the QA/QC programs involving the monitoring systems at the Rocky Flats Plant. Specific information on additions and changes to the current QA/QC programs at the health department and the plant are contained within each individual committee report. These should be applied to any entity that obtains sampling data for the Rocky Flats Plant Any QA/QC program must be compatible across agencies. CDH, RFP and local governments should work to standardize the measuring and testing protocols to allow for comparison of data. The QA/QC plan should be reviewed annually and updated whenever the monitoring program is changed.

13. A formal chain-of-custody protocol should be developed and implemented.

Public health officials must have confidence in the data they receive from the monitoring system in order to make rational decisions. The credibility of data is dependent on a careful system of documentation of sample control. Comprehensive written procedures which are consistent with accepted practice should be developed. The chain-of-custody protocol should include sample labels, sample seals, a field logbook, a chain-of-custody record, sample analysis request sheets, and a laboratory logbook. All samples should be taken and subject to the accepted chain of custody protocol.

## 2.3 ATMOSPHERIC COMPOSITION AND METEOROLOGICAL MONITORING

14. A detailed evaluation of High Efficiency Particulate Air (HEPA) filter efficiency should be conducted.

The small size of the plutonium particle, about 0.045 microns for the plutonium found in the plenums, is on a size range that the efficiency of the HEPA (High Efficiency Particulate Air) filters is in question. These superfine particles may act more like a gas than a particle and pass through the HEPA filter. A study into the efficiency of the HEPA filters in trapping these particles needs to be undertaken.

15. Air samplers for measuring a full spectrum of particle sizes should be added to the monitoring network.

The panel reviewed four types of monitors: 1) TSP, 2) Rocky Flats particulate monitors, 3) PM-10, and 4) large particle samplers. A concern of the panel has been with the actual size of the particles to which the plutonium is attached. The TSP and Rocky Flats particulate monitors are designed for particles of 30 microns or less in size. The PM-10 monitors are designed for 10 micron particles or smaller. The effectiveness of existing samplers in measuring large particles containing attached plutonium has been questioned. This question cannot be answered entirely by a soil sampling program since the source of these large particles may be a combination of resuspension of soil particles and routine plant emissions. The panel recommends that a large particle sampler program be established to determine the extent of plutonium pathways. Such monitoring may provide important information about the pathway of re-entrained plutonium.

The panel also recommends that further review of existing monitors be conducted to ascertain their ability to adequately sample the emissions from the plant. Previous wind tunnel measurements of particle sampling efficiencies should be used to estimate the fraction of large particles which are not collected by the filters.

16. Flow rates through air ducts should be accurately determined.

A significant portion of plant emissions must pass through a series of filter plenums and ducts which then feed into numerous stacks for final release into the environment. The sampling heads in some of these ducts are placed in areas where flow through the duct is not likely to be laminar. The following actions are recommended to be able to determine flow rates through these ducts with an accuracy consistent with the current state of technology.

a. The velocity distribution in each duct at the facility should be measured immediately upstream of the sampling and flow-rating station.

b. Turning vanes or a honeycomb flow straightener in cases of extremely non-uniform flow should be installed.

c. A flow-rate factor for each of the sampling probes in a duct should be established based on measured velocity distribution.

d. Flow-rate corrections for flow meters based on measured velocity distribution should be established.

e. Sensing elements of flow-meters should be cleaned and recalibrated.

17. Equipment for the continuous measurement of Volatile Organic Compounds (VOC's) should be installed.

The measurement and recording of VOC's such as carbon tetrachloride and 1,1,1-trichloroethane as well as oxides of nitrogen should be done on a continuous basis. Recent improved methods based on electron gas chromatography and on chemiluminescence detection have been published by Buhr, Fehsenfeld and others. Some additional development will be required since turn-key equipment may not presently be available for the sampling and analysis.

18. Meteorological monitoring research projects should be conducted at the RFP.

A. The ASCOT (Atmospheric Studies in Complex Terrain) program should be conducted along the Front Range of Colorado, focused at the Rocky Flats Plant.

The ASCOT program has been conducted under the coordination of the Department of Energy since the 1970s in order to develop improved understanding of meteorological flow and pollutant dispersion in a complex terrain. Past programs included the Geysers area of northern California, Brush Creek in Western Colorado, and the Oak Ridge, Tennessee, area.

Northeast Colorado along the Front Range offers a unique opportunity for ASCOT to develop an understanding of atmospheric flow and dispersion characteristics over a larger area than in their past studies. The Front Range already contains a wide variety of meteorological observational platforms. These include: wind profilers, the Mile High radar, the PROFS surface meteorological network, the Boulder Atmospheric Observing Tower and CHILL radars located at Platteville, Stapleton, and Colorado State University.

Conducting the ASCOT program along the Front Range of Colorado would significantly enhance our understanding of atmospheric processes in the vicinity of Rocky Flats. It also would contribute to the general ASCOT goal of developing an improved understanding of the meteorology in complex terrain.

B. TRAC (Terrain-Responsive Atmospheric Code) model developments need to be continued. The TRAC model needs to be verified and validated and additional site evaluations, including tracer studies, need to be conducted.

The location of the Rocky Flats Plant in the transition zone between the Continental Divide to the west and the plains to the east places it in a complex terrain environment. In addition, the river and valley configurations on three sides (with the mountains to the west) provide for difficult modeling. Since most models are developed for flat terrain and then adjusted for complex terrain, few existing models are suitable for estimating ambient concentrations from the emissions from Rocky Flats. None of the EPA approved models are adequate for use in this complex terrain. With this background, the Terrain-Responsive Atmospheric Code (TRAC) was developed as a diagnostic modeling tool to be responsive to both the topographic setting and plant requirements. The model was developed to provide emergency response, risk assessment, and regulatory analyses; it includes representation of the effects of plume rise, surface reflection, terrain, particulate settling, dry deposition (gases and particulates), rain-out, surface roughness, long-term resuspension, and atmospheric stability.

The development of this model or other meteorologic dispersion models would be greatly enhanced with the complimentary ASCOT program recommended above.

19. State-of-the-art prognostic local-scale meteorological models should be applied.

In order to improve upon the current TRAC modeling capabilities, the plant should take advantage of new super work station computer capabilities and implement state-of-the-art prognostic local-scale meteorological modeling. Resources for in-house development of procedures to insert meteorological observations into the prognostic model should be provided. This would provide for an improved combination of modeling and observational capabilities.

20. Particulate transport across RFP boundaries needs to be further studied.

The objective of this particulate transport study should be to establish migration of small radioactive or toxic particles which may have become attached to large particles. This is important in relation to not only meteorological conditions at the plant, but also construction and operational activities.

Essential elements of the research program should include the following:

a. A comprehensive survey of radioactive materials deposited on RFP ground, building and vegetation surfaces.

b. Installation of isokinetic eolian sand traps for collection of large particles at locations along RFP boundaries. The USGS Eolian Sand Trap should be considered for these measurements.

c. Installation of isokinetic eolian sand traps at several locations east and southeast of the RFP property.

d. Investigation of resuspension mechanism around RFP buildings by small-scale physical modeling in a boundary-layer wind tunnel. This approach offers the only method that reproduces atmospheric flow over and around complex arrays of buildings and the associated transport of particulates. Consequently physical modeling is used extensively to establish snow and sand deposition on and around buildings.

21. State-of-the-art transport and dispersion meteorological models should be applied to routine and emergency response needs.

The current EPA approved models are inadequate to characterize dispersion of toxic releases in the area surrounding the plant. Current computer capability has advanced to the point where state-of-the-art transport and dispersion models can be run in real time with the dispersion model linked to the output of the prognostic local-scale meteorological model. Validation of these models should be for specific times and dates and on a case-by-case basis. Validation should also include ground based data.

22. Monitoring of hydrogen fluoride should be conducted.

Rockwell personnel stated that all of the processes using hydrogen fluoride are in closed systems, so loss to the atmosphere is very unlikely. However, the panel believes that possible leaks and handling losses, however unlikely, make it desirable to measure hydrogen fluoride, at least for a trial period, to see whether significant losses occur. If measurements are consistent with background concentrations for several months, then monitoring can be discontinued. These should be source measurements in and around the processing facility.

23. A mobile sampling van program needs to be implemented.

The purpose of the mobile sampling van is two-fold. First it will serve the Rocky Flats Plant and the State of Colorado with an accident and emergency response capability to identify and determine the concentrations of hazardous materials. Being able to move an on-site measurement van to the scene of a spill, fire, or other transportation-related or operations-related location will improve data-gathering and incident mitigation.

The second purpose of the van is to provide a mobile platform for periodic measurements at locations where fixed monitoring does not exist. There is no way to monitor every place in which people live and work around the Rocky Flats Plant. Occasional measurements in surrounding communities can provide reassurance or identify problems not detectable with fixed monitors.

The van also could be used on site to monitor the safety of restoration efforts at various locations, and be moved downwind when meteorological conditions change. This type of monitoring will be valuable in assuring against the threat of public health impacts from disturbance of soils or contaminated ground water.

To make the most effective use of a mobile monitoring system, RFP, CDH and EPA should develop criteria for determining when a mobile sampling effort is necessary.

24. A network of rain/snowfall monitors should be installed as a research project.

Particles emitted from the facility can be removed by "wash out" and/or "rain out" mechanisms. Rain and snow are effective scavengers of large and small particulate matter in the air, though probably not of superfine particles (less than 0.01 micron). If correctly done, rain/snowfall monitors could provide an independent estimate of the emissions from the facility. The most attractive type of monitor for this network appears to be the wet/dry acid deposition type sampling stations, which would also collect bulk deposition samples for this type of analysis.

Adequate background data from areas unaffected by RFP must be obtained in order to make a reasonable assessment of radionuclide concentrations attributable to the Plant. These data must be comprehensive enough to model variability in both time and place and to estimate uncertainty.

If the data are to be analyzed for radionuclides, specific nuclide concentrations should be determined particularly for Pu-239,240.

Methods of analysis and interpretation of the data should be defined before measurements are initiated.

If, after a period of time, the measurements are consistent with background levels of radiation the program should be discontinued.

## 2.4 GROUND AND SURFACE WATER MONITORING

25. Ground water wells without complete documentation should be deleted from the sampling plan.

Ground water wells drilled prior to 1986 do not have adequate construction information. Therefore, the data obtained from these wells are of limited value. It is recommended that these wells be discontinued from the sampling plan and that data previously obtained from these wells be treated separately from new data.

26. Water from the nearest domestic use well down-gradient from the plant should be analyzed for plutonium.

As mentioned previously there are several sources of radiation in the environment. Therefore, it is necessary to determine what amount, if any, of the radioactivity found in well water from areas down-gradient of the plant can be attributed to the plant itself. It is essential that variation in background radiation levels be reported particularly if naturally occurring radionuclides such as uranium are included in the analysis. Uranium concentrations in domestic use wells along the Front Range can vary greatly, with levels over 100 pCi/L not uncommon.

27. Water and sediment from Great Western Reservoir and Standley Lake should be analyzed for plutonium and other radionuclides.

Previous studies indicate that the plutonium is nearly irreversibly bonded to the sediment. This should be verified. Again, background levels of these radionuclides should be determined.

28. Fish samples should be analyzed for plutonium and concentration ratios developed.

This is not likely to be a significant pathway for human exposure; however, the perception of the risk should be addressed. CDH has recently completed an initial study of fish samples taken from Standley Lake. This study should be expanded to include samples taken from Great Western Reservoir and additional samples from Standley Lake. Additionally, background information needs to be obtained for fish taken from other reservoirs in Colorado.

## 2.5 SOIL AND VEGETATION MONITORING ISSUES

29. Soil samples should be taken to determine if disturbance will increase airborne concentrations of pollutants.

The area surrounding the plant may undergo various types of development. Construction projects, such as new roads and buildings, will disturb the soils in this area. A soil sampling program should be conducted to determine if such disturbances will increase airborne levels of pollutants. A soil sampling program should also be conducted on the plant site when areas are to be disturbed.

30. Soil plutonium isopleths should be more accurately drawn.

The Colorado Department of Health may have sufficient data to construct these isopleths. Available data should be examined before additional sampling is recommended. Compatible and valid data from the local governments and other sources should also be used. These isopleths may be helpful in determining the mechanisms and rate of transport off-site. In addition, this type of information may be helpful with regard to perception of radiation risk from Rocky Flats.

31. A statistically valid number of soil samples should be analyzed for Am-241/Pu-239, 240 and for the development of plutonium ratios.

The variability in those ratios should be quantified and 90 percent confidence limits determined. The current method of assuming a value of 20 percent of Pu-239, 240 for Am-241 is conservative. The calculated ratio at maximum ingrowth of Am-241, based on an assumed weight percent of Pu-241 in weapons grade plutonium of 0.36 percent is approximately 0.15. The calculated method used by CDH should be documented. The determination of Am-241/Pu-239,240 may only need to be done one time. However, in reporting Am-241 concentrations it should be specifically noted that the numbers represent maximum ingrowth not necessarily the current concentration.

32. Radionuclide analysis of forage and foodstuffs raised in the vicinity of the plant should be conducted periodically, perhaps at five year intervals.

This recommendation is not based on any current evidence suggesting a threat to human health, but rather on the need to continue to monitor these resources. The public perception of the risk associated with Rocky Flats includes contamination of food and water. As with other recommendations it is essential that background radionuclide information be determined for comparison.